



JRC TECHNICAL REPORT

Guide for EF compliant data sets

Version 2.0

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Abstract

This document provides additional guidance, in addition to the ILCD entry-level requirements¹ (JRC 2012), in order to develop process data sets, compliant with the Environmental Footprint (EF) requirements.

This document provides further details on more specific aspects and procedures related to EF compliant data sets, and it is divided in different sections:

1. The definition of the different process data set types allowed in the ILCD Format.
2. EF Reference packages released (description and where to find them)
3. How to structure and document data stocks
4. The procedure for EF compliant data sets and data stocks² updates, describing how to update and document changes in the future releases of EF compliant data sets, replacing older versions with new ones.
5. Harmonization of level – 1 disaggregated data sets, including the level of disaggregation for the EF requirements, and the additional documentation needed.
6. Requirements for meta-data information of EF compliant data sets, describing where and how to include the documentation.
7. Modelling requirements, specific for EF framework
8. Reviewer's requirements and review report, including the minimum level of expertise for a reviewer (or a team), in order to be eligible for the EF compliant data set's review, and the review report template, with explanations on how to fill in the different fields.

¹ <https://eplca.jrc.ec.europa.eu/uploads/ILCD-Data-Network-Compliance-Entry-level-Version1.1-Jan2012.pdf>

² Each node, managed by each data provider, can contain different data stocks with different data, and available under different conditions (e.g. free access, access only to registered users, etc.)

Acknowledgements

The definitions of data set types in chapter 1 were drafted by Dr. Marc-Andree Wolf (MaKi Consulting). The overall document has been drafted in collaboration between JRC and DG ENV.

Introduction

Since 2007, the Joint Research Centre, in collaboration with the DG Environment, developed the International reference Life Cycle Data (ILCD – JRC 2010b) format, and compliance system, responding to several policy needs over years, both at the EU and international level.

In 2013 the “communication from the commission to the European parliament and the council *Building the Single Market for Green Products Facilitating better information on the environmental performance of products and organisations*” (COM/2013/0196) endorsed the creation of the Product and Organisation Environmental Footprint methods (PEF and OEF, respectively, or generically EF) (2013/179/EU).

According to the new needs, and the updated methodological approach, the ILCD compliance system³, as well as the format, the reference packages and the meta data to be used, had to be slightly reviewed.

This document provides additional guidance, beyond the documentation available for ILCD Life Cycle Inventory (LCI) data set development, on how to develop and model LCI data compliant with the EF requirements.

EF compliant Life Cycle Inventory (LCI) data sets shall be compliant with:

- EF ELEMENTARY flows: the nomenclature shall be aligned with the most recent version of the EF reference package available on the EF developer’s page at the following link <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>. Details to fulfil this aspect are available in the “ILCD Handbook – Nomenclature and other conventions” (JRC 2010a)⁴
- For the PROCESS data sets and PRODUCT flow, the nomenclature shall be compliant with “ILCD Handbook – Nomenclature and other conventions” (JRC 2010a)

³ Note that ILCD compliance system exists next the EF compliance system. It is recommended to use the EF flow list (to be found in the EF package) for ILCD compliant datasets.

⁴ <https://eplca.jrc.ec.europa.eu/uploads/MANPROJ-PR-ILCD-Handbook-Nomenclature-and-other-conventions-first-edition-ISBN-fin-v1.0-E.pdf>

1 Process data set types differentiated in ILCD format⁵

Unit process, *Unit operation type unit process that cannot be further subdivided. Covers multi-functional processes of unit operation type*⁶.

single operation Additional explanation: This data set type is used exclusively for process steps that cannot be usefully further subdivided in terms of data collection for delivering the functional unit or reference flow. Examples are unit operations or grouped operations in chemical engineering, such as mixing, chemical reactions, crushing, and transport etc., but also machines with either only one function or product output, or - for multifunctional processes - where the co-functions/products all undergo the same processing steps. An injection moulding machine, a truck transport, a catalytic cracker plant at a refinery, and the farming of a crop are concrete examples. "Unit process, single operation" processes are hence undistorted among co-functions (in contrast to many "Unit process, black box") and allow for a more reliable review, even though they may combine more than one technical components and steps.

Unit process, *Process-chain or plant level unit process. This covers horizontally averaged unit processes across different sites. Covers also those multi-functional unit processes, where the different co-products undergo different processing steps within the black box, hence causing allocation-problems for this data set.*³

black box Additional explanation: Examples are plants and process chains or whole production sites ("gate-to-gate" processes) where co-functions/products do NOT all undergo the same process steps, but interim products are taken out, while others are further processed. A classic example is the oil refinery, with e.g. Butane is a product of the first plant, the atmospheric distillation plant, which hence receives very little energy consumption and related emissions, while low-sulphur Diesel or Gasoline are two of the last products that underwent on different routes up to a dozen of plants inside the refinery, with a several times higher energy consumption and emission per product amount. "Unit process, black box", can hence be both vertically aggregated and/or horizontally averaged, are often distorted among co-functions/products and moreover can less reliably be reviewed, given that they combine several processes vertically or horizontally.

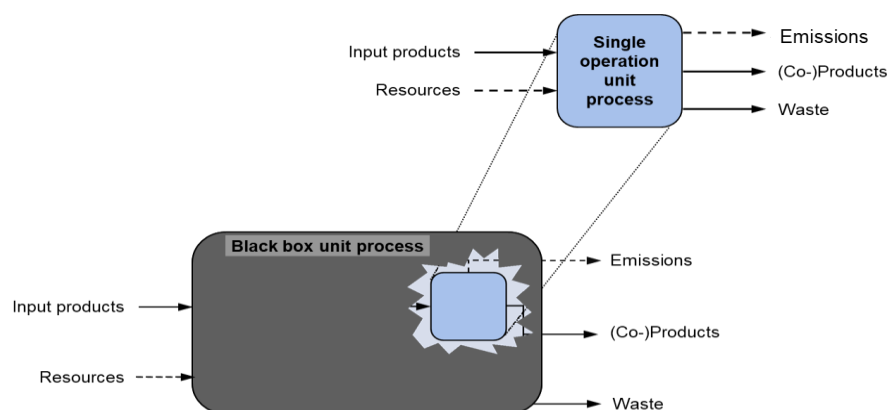


Figure 1. Unit process, single operation vs Unit process, black box (taken from the ILCD handbook – General guide for LCA, figure 7, page 75).

⁵ https://eplca.jrc.ec.europa.eu/LCDN/downloads/ILCD_Format_1.1_Documentation/ILCD_Common_EnumerationValues.html

⁶ This dataset type is the one also that has to be used for supporting sub-processes as further described in chapter 3

LCI result

Aggregated data set of the complete or partial life cycle of a product system that next to the elementary flows (and possibly not relevant amounts of waste flows and radioactive wastes) lists in the input/output list exclusively the product(s) of the process as reference flow(s), but no other goods or services. E.g. cradle-to-gate and cradle-to-grave data sets. Check also the definition of "Partly terminated system".³

Additional explanation: Examples are process nets that include all human upstream activities that transform natural resources into a desired product/function (or functions/products, in case of multifunctional data sets). Such aggregated data sets (also named Ecoprofile, System process) provide the life cycle inventory for the provision of e.g. 1 kg Corn at the farm gate, 1 kWh low voltage electricity delivery to the consumer, 1 m² wool carpet incl. maintenance and end-of-life treatment, or of 1 MW wind power plant of a specific model and installed at the foreseen site. Also end-of-life treatment chains/nets of a defined amount of a defined waste (i.e. waste collection, pre-treatment and treatment such as recycling, energy recovery, landfilling of the remains) are an LCI result data sets, as long as exclusively the to-be-treated waste is the only non-elementary flow. (Note that in all cases, radioactive waste flows and quantitatively irrelevant amounts of other waste flows are allowed to stay in the inventory.)

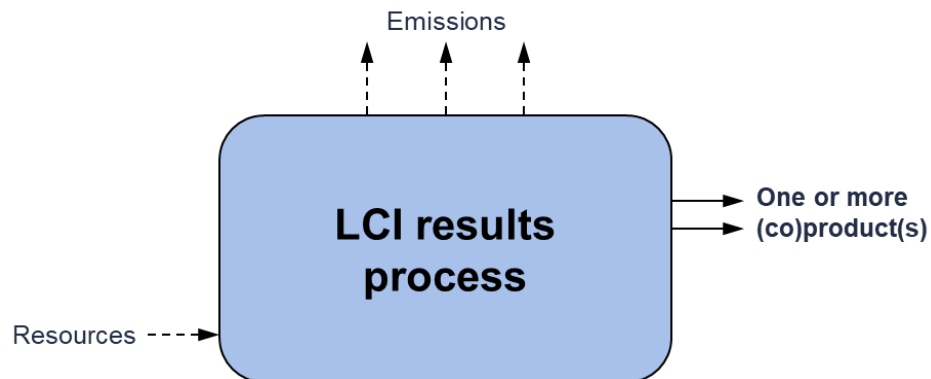


Figure 2. LCI result (Only radioactive waste flows and quantitatively irrelevant others waste flows may remain in the inventory; not shown.)

Partly terminated system

Aggregated data set with however at least one product flow in the input/output list that needs further modelling, in addition to the reference flow(s). E.g. a process of an injection moulding machine with one open "Electricity" input product flow that requires the LCA practitioner to saturate with an Electricity production LCI data set (e.g. of the country where the machine is operated). Note that also aggregated process data sets that include relevant amounts of waste flows for which the waste management has not been modelled yet are "partly terminated system" data sets.³

Additional explanation: This data set type is used to provide largely complete (almost) LCI result data sets that require (and allow) to exclusively connect one or a few specific background data sets, while all other upstream (and/or downstream) processes are already included and aggregated. This reduces modelling and review effort and increases reproducibility, while it naturally and intentionally limits other changes to the data set.

Note: this is the data set type to be used for EF "partly disaggregated at level-1".

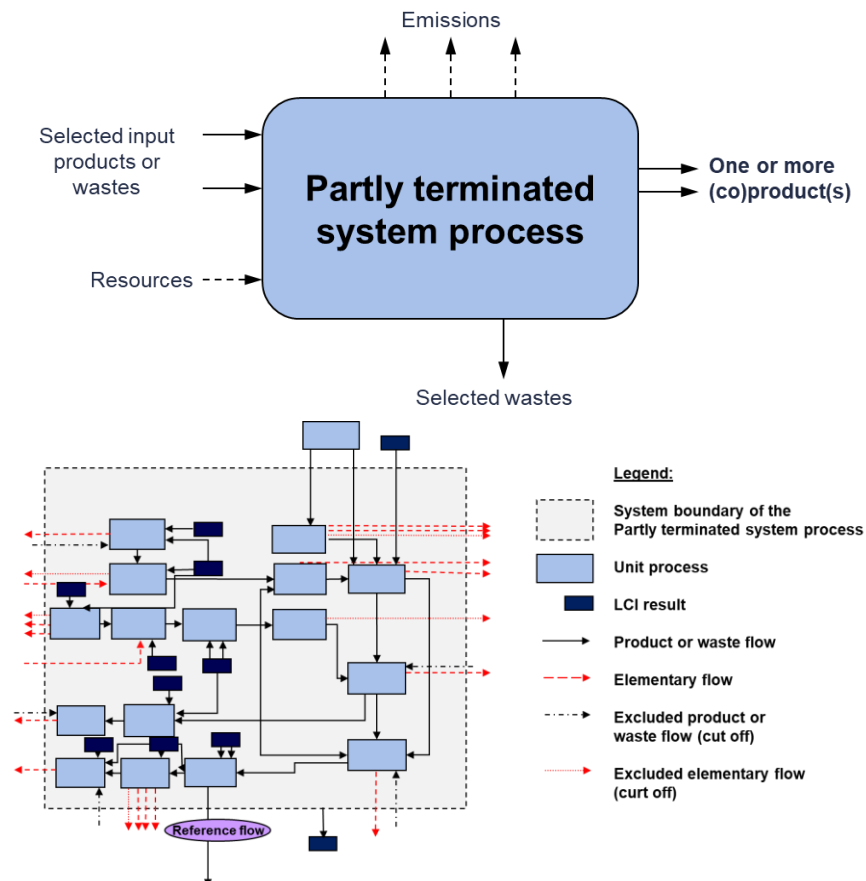


Figure 3. Partly terminated system process (overview, top; detail, illustrative, bottom) with at least one not included product or waste input flow or waste output flow that is still to be modelled to yield a LCI result data set. Note that wastes are sometimes modelled output flow, sometimes as service input flow.

Parameterized Data sets in which part or all of the exchange values, scale through some data sets characteristic parameter of the output product or service. Modelling variables, to be detailed in the documentation, in the section "mathematical model".³

The mathematical relations should represent the relevant changes of the inventory in dependency of the influential parameters, which can be e.g. technical, management, or others. This can include quantitative and qualitative relationships among inventory flows.

2 EF reference packages released

The EF reference package is released by the European Commission and is distributed in form of a compressed ZIP archive, containing a set of files and folders in accordance with the ILCD format specification as follows (folder names in **bold**):

- **ILCD** (containing the reference folders with XML files external docs and other files)
 - contacts** (files defining contacts in ILCD format – XML)
 - external_docs** (files linked in other XMLs, e.g. reports in PDF, images, etc.)
 - flowproperties** (files containing the flow properties linked to flows – XML)
 - flows** (Files containing elementary, product, waste and other flows – XML)
 - Iciamethods** (files containing the list of CFs for each impact category –XML)
 - processes** (files containing process data sets – XML)
 - sources** (files defining sources in ILCD format – XML)
 - unitgroups** (conversion factors from default to other units – XML)
- **META-INF** (contains MAINFEST.MF, a technical file of no relevance for users)
- **Other** (contains additional files: validation profile, Look@LCI configuration file and package converter)
- **Schemas** (contains XSD files with the XML schemas of the ILCD format)
- **Stylesheets** (contains XSL files defining the styles applied to XML data)

The reference package contains also functional configuration files or tools related to the package itself, available in the “other” folder:

- validation profile for the Validation Tool
- configuration file for Look@LCI ⁷
- an automatic converter to convert process data sets from the previous version to the new version

Each version is released together with an excel file resuming the content of each package, and with a change log that reports the differences between the latest release and the previous version.

The two EF reference packages released by the EC are available following this link:

<https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml> :

EF 3.0 reference package (December 2018), including all the reference files + additional documentation in ILCD structure. It includes the configuration files for validation and analysis with Look@LCI⁸ and automatic converter from EF 2.0 to EF 3.0. New PEFCRs/OEFSRs developed during the EF transition phase shall use this EF reference package in their underlying data sets, as well as EF studies using these new PEFCRs.

EF 2.0 reference package (June 2018), contains the same items available in EF 3.0, but referred to the previous version, except for the automatic converter. Part of the nomenclature, methods and other items are of course different. This reference package is

⁷ The reference EF package is mandatory for the execution of Look@LCI, as explained in the dedicated guidance https://eplca.jrc.ec.europa.eu/permalink/TR_look_at_lci.pdf the software automatically picks from the package the methods (CFs for calculation) and the configuration file for the normalization and weighting factors for different impact categories.

⁸ https://eplca.jrc.ec.europa.eu/permalink/TR_look_at_lci.pdf

used in the PEFCRs/OEFSRs developed during the EF Pilot phase and shall be used by all EF studies using these PEFCRs.

3 Procedure for updates of EF compliant data sets and data stocks

3.1 Conditions to update EF compliant data sets and data stocks

The EF compliant data sets and data stocks (i.e. the homogeneous stocks of data set within a node in ILCD or EF registry⁹) shall be updated in the following cases:

Case A) changes in process data sets, without changing the EF reference package¹⁰

A1- affecting core content* of the data

A2- not affecting the core content* of the data

Case B) update of the EF reference package that do or do not lead to changes in the core content of the data

**core content is defined as: changes in LCI, DQRs, LCIA Results and process name, or any 'semantic' change in core objects (e.g. change in flow properties, or units etc.).*

The data providers are free to upload new data into the nodes they manage, with no limitation in time.

For all the cases mentioned below, the data provider shall indicate the changes on the landing page of the node¹¹, together with the date of the changes and the excel files with the overall and/or data set-specific change logs where requested (or in a specific repository linked from the landing page).

3.2 Procedure for updates that affect the core content of the data set (case A1) ¹²

The "Overall change log" template (available at <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>) shall be used to summarize all the changes occurred in the entire data stock. The file name of the overall change log shall be the name of the data stock pre-update.

Data set-specific change logs ("Core changes template" available at <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>) shall be filled in for each single changed data set, in order to document the changes occurred. The Excel template differentiates between main changes (affecting the core content) and 'other' changes (to document minor changes that occurred). The file name of the data set-specific change log shall be the UUID of the data set pre-update.

Two exemplary files, for the instructions on how to fill the information in the change logs, are available at:

https://eplca.jrc.ec.europa.eu/permalink/EXAMPLE_OVERALL_log.xlsx

https://eplca.jrc.ec.europa.eu/permalink/EXAMPLE_CORE_CHANGES_log.xlsx

As the core content has changed due to corrections made by the data provider, the new data sets shall: (i) have an updated review (full or partial, i.e. update only the review of

⁹ See this link for further info: <https://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml>

¹⁰ The package in ILCD structure provided by the European Commission, that includes reference items such as elementary flows, flow properties, unit groups, methods etc. available at <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>. Shortly named 'EF package'.

¹¹ A template for consistent change reporting on the landing pages of different nodes will be released by the EC as soon as possible, through the EF developer's page (<http://https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>)

¹² As regards the templates mentioned in this section, the EC is developing a tool, in order to extract some of the relevant info automatically, the tool will be available as soon as possible in the EF developer's page, see the link in the footnote above. Also a new version of soda4LCA and a template for consistent communication to data user is under development and will be announced and released through the above mentioned page.

the parts that changed), (ii) carry a different UUID, (iii) be hosted on the same data stock¹³, and (iv) the superseded data sets shall be linked into the new data set (under Administrative information > publication and ownership > preceding data set version¹⁴). The name of the updated EF compliant data set shall be updated, starting with "Updated+year" and if needed other indicators in the name that differentiate the data set from the previous version. The original data set (pre-update) shall remain available on the node.

This procedure is NOT valid for datasets that are correctly used in the PEFCR/OEFSR but wrongly uploaded on the data node. In this case, the procedure in A2 (chapter 3.3) shall be followed.

3.3 Procedure for updates from the data provider that do not affect the core content of the data set (case A2)

In case A2 (no core changes made by the data provider), the updated data sets shall: (i) keep its original UUID, (ii) be hosted on its original data stock, and (iii) have an updated version number. The original data set (pre-update) shall remain available on the node (i.e. the data provider shall not delete the old version of the data set).

The "Overall change log" template (available at <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>) shall be used only to summarize all the changes occurred in the entire data stock. The file name of the overall change log shall be the name of the data stock (pre-update) and shall be shared on the node.

3.4 Administrative steps for cases A1 and A2

A number of administrative steps shall be taken by the data provider.

1. At time of error identification in a dataset, the data provider shall:
 - a. Inform all users registered on the node about the UUID, version number and name of the datasets concerned (email).
 - b. Indicate on the landing page of the node the UUID, version number and name of the datasets under revision.
 - c. Take the affected datasets offline.
2. At time of uploading corrected datasets, the data provider shall:
 - a. Upload the corrected datasets without download functionality (E.g. in a restricted access node).
 - b. Inform the EC + EF helpdesk about the new upload with Name, UUID + link to the datastock + email of stakeholder who raised the concern¹⁵.
3. Upon greenlight from the EF helpdesk¹⁵⁻¹⁶, the data provider shall:
 - a. Make the datasets available for download
 - b. Inform all users registered on the node about the UUID, version number and name of the datasets concerned, plus the ICs changed (email).

¹³ If the majority of the data package in the data stock is updated, a new data stock might be necessary.

¹⁴ Here, the UUID **and** version number of the superseded dataset need to be specified, as well as its URI. For the URI, use the pattern without specifying the data stock but indicating the previous dataset's version, e.g. <https://www.mycompany.com/lca/processes/50f12420-8855-12db-b606-0900210c9a66?version=01.00.000>

¹⁵ After the end of the EF transition phase those parts will be modified

¹⁶ The EF Helpdesk will (i) check (or spot-check in case of systematic changes across different datastocks) if the changelog of the uploaded dataset correctly describes the changes made in the dataset and (ii) ask the stakeholder who raised the concern if the changelog adequately addresses the concerns raised (response time of 5 working days, otherwise the dataset is assumed to be conform).

3.5 Procedure for updates due to the EF reference package update (case B)

In case B (any change due to the adaptation to a new EF reference package) the updated data sets shall: (i) keep their original name and UUID, (ii) have an updated version number, (iii) be hosted on a new data stock, and (iv) the original data set shall be linked into the new data set (Under Administrative information > publication and ownership > preceding data set version). The data set shall be updated declaring compliance with the new EF reference package. In the field "compliance declarations", the compliance system name shall be filled in by selecting the corresponding source data set (available on the EF node under the 'representative product' data stocks) and the compliancy requirements shall be filled in accordingly. The new data stock shall carry the same name of the previous one, but the name shall start with the reference package+version (e.g. "Representative product" data stock, converted from EF 2.0 to EF 3.0, will be stored in a data stock named "EF3_0_representative_products" while the previous version of the data stock was "EF2_0_representative_products"). The original data sets (pre-update) shall remain available on the node, in its original data stock.

The "Overall change log" template (available at <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>) shall be used only to summarize all the changes occurred in the entire data stock or an entire data package release. The file name of the overall change log shall be the name of the pre-updated data stock.

Note that all data sets within the same data stock shall be updated with the same version of the EF reference package and a complete data package shall be provided in each data stock. The provider shall indicate the changes on the landing page of the node, together with the date of the change and the overall change log excel file (or in a specific repository linked from the landing page). The provider shall register the updated data sets in the EF registry (LCDN - <https://lcdn.jrc.ec.europa.eu/EFRegistry/>) and notify the EC via the functional email env-environmental-footprint@ec.europa.eu.

3.6 Procedure for updates for tendered EF compliant data sets

Data tenders following specific Terms of Reference launched by the European Commission, are usually referable to case B, therefore only a single overall change log is required.

If other changes are made by the providers affecting the content of process data sets, beyond the changes due to the adaptation to a new EF reference package, then the situation can reflect cases A (A1 or A2 depending on the entity and type of changes). In this case, the above described procedures for the specific cases have to be adopted.

4 Harmonization of EF compliant data sets partly disaggregated at level-1

EF compliant data sets can be developed both as aggregated data sets (type:LCI result) and partly disaggregated (at least at level-1¹⁷) (type: partly terminated system). Fig. 3 provides a graphical representation of what is meant with partly disaggregated data set at level-1.

As a minimum, the central data set shall be aggregated at level-1 with the different inputs and outputs structured as follow (see figure 4):

¹⁷ The notation „level-1 data set“ is also used in this document

- Sub-processes for energy: to be modelled as input(s), one single sub-process per energy dataset, including any potential energy conversion of fuels and thus direct emissions, as "steam from [name of fuel]", or "process heat from [name of fuel]";
- Sub-processes for transport: to be modelled as input(s), one single sub-process for each transported material/ingredient/component and transport dataset entering the gate of the central dataset modelled. Meaning, each different transport dataset (e.g. lorry euro 4 or lorry euro 5) shall be modelled as a different dataset input. The transported weight and distance shall be modelled as a combination of two separate parameters at the level of the central dataset;
- Sub-processes in case system expansion is used as allocation: Product flow used to model avoided product systems shall be modelled as output(s) and indicate "Avoided product system" in the field "Type of dataset". Use the original datasets and deliver a simple inverter (dummy process in the figure below) as modelling process, i.e. one that changes the inventory number of the connecting product flow from plus to minus (e.g. 1.5 kg to -1.5 kg).
- Sub-processes for the main materials input to the product in scope, to enable the modelling of virgin or recycled materials input and the adaptation of the recycled content (R_1 value of the Circular Footprint Formula).
- One aggregated sub-process for all remaining processes that represent the background system (blue box in the figure below), to be modelled as input;
- The output product flow. Multiple (non-identical) output product flows are allowed, but one reference output product flow shall be defined in the field "Reference to reference flow". This can be an input or output flow and shall be defined in the dataset;
- One sub-process with all direct emissions and resource inputs (e.g., land use, water use) of the foreground system constituting the final output product.

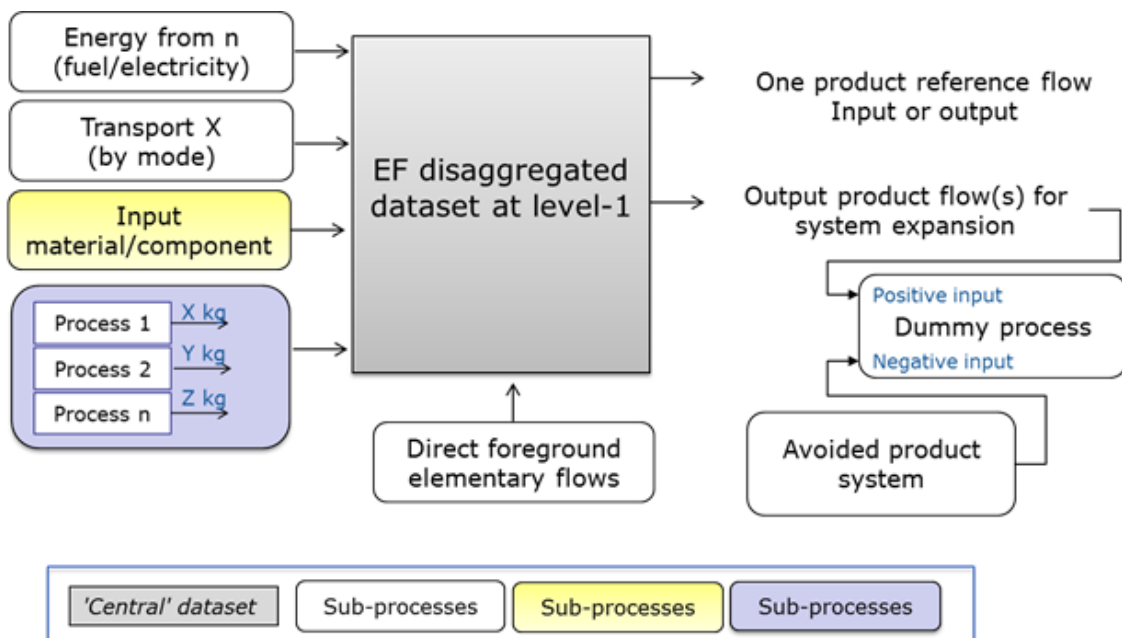


Figure 4. Minimum level of disaggregation requested for a data set disaggregated at level -1. The yellow box is optional when going beyond the minimum requirements. The grey box is named 'central data set'.

Guidelines on which data sets to use for modelling (disaggregated) EF compliant data sets can be found in chapter 6.

Further requirements for level-1 data sets are:

- Sub-processes used to structure the model like life cycle stages, transport mixers, aggregated sub-processes of several EF/ICLD compliant processes used in the central data set (blue box in the figure above), or the direct emissions of the central dataset, can be used and shall follow the specific requirements indicated in chapter 5.4.
- All sub-processes developed or used to model the newly EF-compliant data set shall be in line with the version of the EF reference package applied in the central data set.
- Duplicated input or output elementary flows are allowed. For dataset users, the European Commission will provide a tool to merge multiple elementary flows with the same UUID (Universal Unique IDentifier) and same location code. Flows with the same UUID but different location codes will not be merged. The tool will also concatenate the general comments behind the flows¹⁸, and report in brackets the mean value of each of the original single flows.
- Duplicated input or output product/waste flows are not allowed. The flow type 'others' shall not be used.

The European Commission is developing an extended ILCD format. The goal of this format is to enable the exchange of disaggregated datasets among software in a more automated way. Once the new format is available, additional documentation will be provided.

¹⁸ Note for the dataset provider of duplicated flows, the concatenated comment field has a limit of 500 characters and everything beyond that limit will be cut off. Therefore the length of comments in duplicated flows shall be limited, and ideally be about 450 characters (to leave space for the amounts) divided by the number of flows to be merged.

5 Requirements for meta-data information in EF compliant data sets

5.1 General information

This section provides binding requirements on the meta-data information in EF compliant data sets. These are in addition to the ILCD-Entry Level requirements. The ILCD data format documentation contains detailed descriptions of the individual format fields and is available <https://eplca.jrc.ec.europa.eu/LCDN/developerILCDDataFormat.xhtml> online at <https://eplca.jrc.ec.europa.eu/LCDN/developerILCDDataFormat.xhtml>. This documentation shall be used to avoid mistakes in data filling such as exceeding the number of allowed characters or setting a wrong value in a field. Unless specific guidance is given below, please refer to the definitions and explanations given there.

This chapter is divided in four sections:

1. Information relevant for all data sets
2. Additional information only relevant for aggregated data sets in ILCD format
3. Additional information only relevant for disaggregated data sets in ILCD format
4. Information to be provided in supporting sub-processes.

5.1.1 conventions

Type of data set refers to a field in the ILCD data format.

Value from enumerated list refers to a value from an enumerated list for a specific format field, i.e. the entry is to be selected from a predefined and fixed list of possible entries.

Free text value refers to a free text value for a specific format field.

5.2 Information relevant for all data sets

The ILCD format specification¹⁹ and the corresponding XML Schemas already define part of the information to be filled also in the EF compliant data sets. Beyond the information specified in the sub-chapters of this section, the following information shall be mandatorily filled according to the ILCD format specification:

¹⁹ https://eplca.jrc.ec.europa.eu/LCDN/downloads/ILCD_Format_1.1_Documentation/ILCD_ProcessDataSet.html

- **Name** and **UUID** shall be reported under the section “process information > key data set information”, the name shall be structured according to ILCD rules (base name – treatment, standards, routes – mix and location types – quantitative product or process properties)
- **Data set version** and **Date of last revision** shall be defined and updated in case of changes under “administrative information > publication and ownership”. The version number is structured with three sets of digits XX.XX.XXX where the first two digits refer to major updates, the second two digits to minor revisions and error corrections etc. The last three digits are intended for automatic and internal counting of versions during data set development. The date of revision shall be formatted according to ISO 8601 standard in date-time format. *E.g. YYYY-MM-DDTHH:MM:SS+HH:MM²⁰ (the “T” separate the date from the time, and after the “+” is reported the time zone respect to GMT)*
- Under “process information > quantitative reference”, the reference flow of the dataset shall be referenced under **Reference to reference flow** or the **Functional unit** shall be reported (see chapter 4 and 6 for further details).
- Cut-off criteria and principles, where applicable, shall be described in “modelling and validation > data sources, treatment, and representativeness” section under **Data cut-off and completeness principles** and **Deviation from data cut-off and completeness principles / explanations**
- All the information on **Type of review** and **Reviewer name and institution** shall be specified under “modelling and validation > validation field”, for the reviewer name and institution field, multiple entries can be given
- As regards the **Administrative information** and **Publication and ownership** the fields shall be compiled following the level of recommendation of the format specification for process datasets ²¹ (beyond the specific sub-fields further specified in this chapter).
- **intended applications** shall be documented
- **workflow and publication status** shall be documented
- The LCI method and deviations if any, shall be described under “modelling and validation > LCI method and allocation” in the fields **LCI method principle**, **Deviation from LCI method principle / explanations**, **LCI method approaches**, and **Deviations from LCI method approaches / explanations**
- **License type** shall be declared under “administrative information > publication and ownership”
- Under **Use advice**, specific methodological advice for data set users that requires attention shall be given. E.g. on inclusion/exclusion of recycling e.g. in material data sets, specific use phase behaviour to be modelled, and other methodological advices. Shall be documented, if any.

Flow diagrams of the system boundaries, including sub processes where relevant (see chapter 5.3) shall be linked (with a source dataset + pictures or graphs) under “process information > technological representativeness” in the field **Flow diagram(s) or picture(s)**.

5.2.1 Data set LCA report, background info

In the field **Data set LCA report, background info**, if a PEF study is performed, the PEF report shall be referenced.

²⁰ <https://www.iso.org/iso-8601-date-and-time-format.html>

²¹ https://eplca.jrc.ec.europa.eu/LCDN/downloads/ILCD_Format_1.1_Documentation/ILCD_ProcessDataSet.html

5.2.2 Type of process

The available options for the field *Type of data set* are explained in detail in chapter 1 “**Error! Reference source not found.**”.

Specifically in the EF context, for aggregated data sets, use *LCI result*, and for partly disaggregated data sets, use *Partly terminated system*.

5.2.3 Geographical representativeness

To refer to the complete EU, the following string has to be used: “EU+EFTA+UK” for the single countries the “two-letter ISO country code”²² for countries, has to be used.

5.2.4 Reference year

From the ILCD data format specification: “Start year of the time period for which the data set is valid (until year of ‘Data set valid until:’). For data sets that combine data from different years, the most representative year is given regarding the overall environmental impact. In that case, the reference year is derived by expert judgment. “The reference year shall not be changed for data set updates (i) due to a change in EF reference package or (ii) that do not affect the LCI content.

5.2.5 Default parameter values

For parameterized data sets, the respective default value shall be given for each parameter (e.g., the utilization ratio in transport data sets) in the *Comment, units, defaults* field within the *Mathematical model* section.

5.2.6 Regionalized elementary flows

All locations are allowed for modelling of elementary flows in the impact categories Land Use and Water Use. In all other cases, regionalization is only allowed for substances and countries reported in annex I.

5.2.7 Duplicated elementary flows

Duplicated elementary input/output flows are allowed. The source of the flow **shall** be documented in the comment field next to the duplicated flows.

5.2.8 Allocation

The allocation methods listed in *LCI method approaches* should reflect those used for both the foreground system and background systems. In the corresponding explanation field *Deviations from LCI method approaches / explanations* detailed information shall be given, indicating separately the allocation used in the foreground and background system.

5.2.9 Element content

The water content and the biogenic carbon content at factory gate (physical content) shall be reported only if different from zero. **If derived from native²³ forest, it shall report that the corresponding carbon emissions shall be modelled with the elementary flow ending with ‘Land use change’.** This information characterizes the product (and not the process). Therefore, it needs to be stored in the reference flow (which is a product or waste flow) by means of individual flow properties. The element content is modelled by

²² See “alpha-2 codes” at <https://www.iso.org/obp/ui/#search>, additional codes are added, in EF framework namely: PT-MA (Madeira), ES-CA (Canary Islands), BQ-SE Bonaire Saint Eustatius, BQ-SB Bonaire Saba.

²³ Native forests – represents native or long-term, non-degraded forests. Definition adapted from table 8 in Annex V C (2010)3751 to Directive 2009/28/EC. In principle, this definition excludes short term forests, degraded forests, managed forest, and forests with short-term or long-term rotations.

referencing the corresponding flow property (e.g. “carbon content”) and giving a value (which corresponds to that flow property’s reference unit, which usually should be kg) in the flow data set that represents the product flow (see Figure 5 as example of the actual data set displayed on the node, the reference flow is always available as a hyperlink as shown in figure, and figure 6 that explains the modelling). The example below shows the relationships for a product flow with a carbon content of 0.43 kg and a water content of 0 kg.

Process data set overview page		
Data set: Corrugated board, uncoated (18.05.007)		
Full name Corrugated board, uncoated; Kraft Pulping Process, pulp pressing and drying; production mix, at plant;		
Reference flow(s)		Type LCI result
◦ Corrugated board - 1.0 kg (Mass)		
Category Materials production / Paper and cardboards		

Figure 5. Hyperlink to the reference flow in the process data set

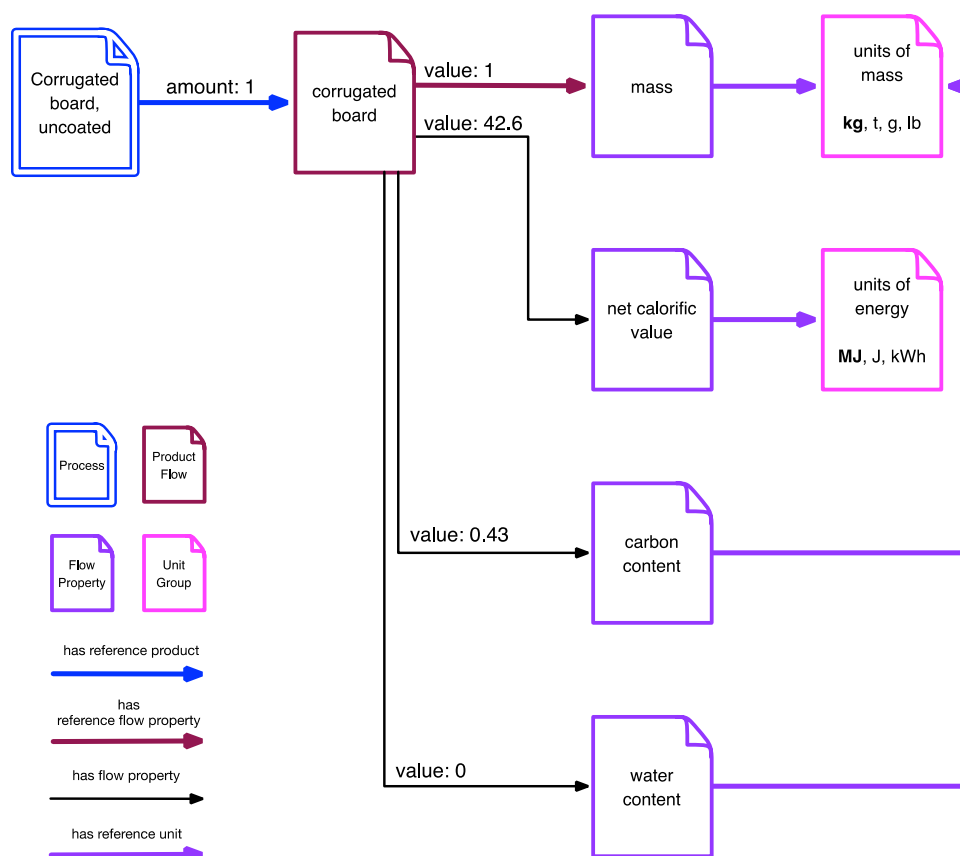


Figure 6. Modelling element content

When following this link, the product flow data set can be inspected, which in addition to its mandatory reference flow property can have an arbitrary number of additional flow properties, as shown in figure 7. In this case biogenic carbon and water contents are declared.

Product Flow Data set: Corrugated board (en)		Administrative information			
Flow information		Flow Properties			
Data set information		Flow Property	Mean value	Minimum value	Maximum value
Name	Corrugated board	Mass	1.0	0.0	0.0
Classification	Class name : Hierarchy level ILCD: Materials production / Food and	Water content	0.0	0.0	0.0
Quantitative reference		Carbon content (biogenic)	0.43	0.0	0.0
Reference Flow Property	Mass (kg)				

Figure 7. Element content flow properties in a product flow

5.2.10 CFF parameters

The Circular Footprint Formula (CFF) parameters used shall be provided in the existing field *Deviations from LCI method approaches / explanations* as textual description. It shall be defined where the CFF has been applied. The CFF parameters shall be reported unless they are zero (e.g., $R1=0$) and the landing page shall provide a general documentation that parameters not documented are equal to zero.

5.2.11 Modelling constants

The field *modelling constants* shall indicate as a minimum how biogenic carbon has been modelled, if emission off-setting is applied and if capital goods are excluded.

5.2.12 LCA methodology report

The source data set of the most recent version of the PEF method shall be referenced in the field *LCA methodology report*. If relevant, also the source data set of the applicable PEFCR shall be referenced.

5.2.13 Data sources used for this data set

In the field *Data sources used for this data set* the EF compliant data stocks plus the data source(s) used for gap filling are to be referenced. Each shall be referenced as one source data set of the respective data stock. EF compliant data stock sources are usually available at <https://eplca.jrc.ec.europa.eu/EF-node/>.

In order to get the proper source:

- Go to the EF-node of the EC (see link above)
- Go to the "representative product" data stock (using the top right drop-down menu) referred to desired EF reference package (e.g. **EF2_0**_representative_products for data stocks, developed in compliance with **EF 2.0**).
- Select "sources" from the left side-bar,
- use the search by name, typing "EF X.X Compliant" where X.X is the version of the EF reference package desired (e.g. **EF 2.0** compliant)
- select the source(s) from the displayed list as shown in the following screenshot

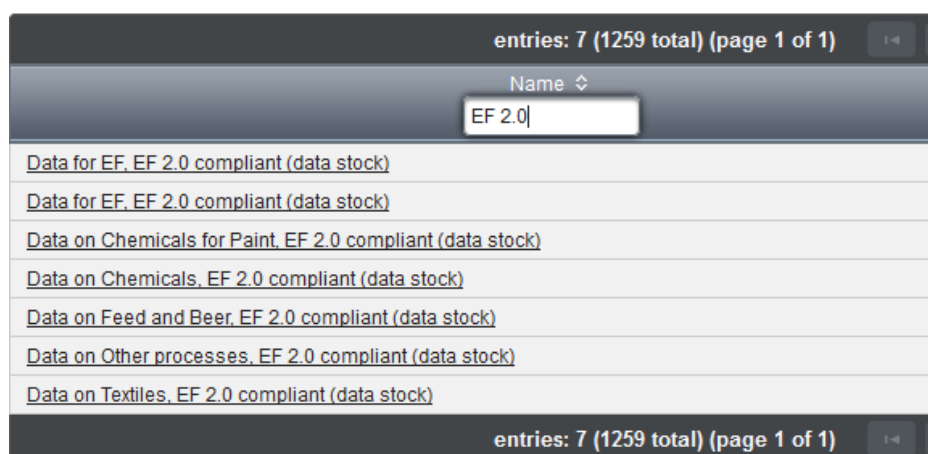


Figure 8. Search of sources in the Representative Product data stock

5.2.14 Reference to supported impact assessment methods

Add exclusively and individually references/hyperlinks to the source data sets of the EF impact categories applied.

5.2.15 Compliance

For EF compliant data sets, the following 6 compliance systems shall be listed (no others can be listed), if there are no PEFCRs only 5 can be used:

Table 1. Compliance system and related source datasets allowed in EF scheme

Compliance declaration	Source dataset UUID	Level of compliance aspect
PEFCR guidance 6.3 ²⁴ Or OEFSR guidance 6.3 ¹⁷ Or Suggestions for updating the PEF method 2019 Or Suggestions for updating the OEF method 2019	e2ecfeb8-078c-4cee-9885-7135d35e4f10 Or bb3e3630-543f-4210-97b0-2a239e40c0c0 Or afc1ce43-e800-494b-aad4-46b9e8ea74da Or 37d1d84f-0d67-4386-b1d1-a096eecb3274	Modelling specific compliance. All compliance aspects shall be set at "Fully compliant" (Note: those sources are used to declare the overall PEF/OEF compliance)
The PEFCR used, if applicable	Use the dedicated source data set available in the "sources" section of the package specific data stocks at: https://eplca.jrc.ec.europa.eu/EF-node/	All compliance aspects shall be set at "Fully compliant"
ILCD Data Network entry-level	d92a1a12-2545-49e2-a585-55c259997756	The quality compliance shall be set at "Not defined". All other aspects shall be set at "Fully compliant"
ISO 14040	1ea48531-e397-4ca7-ac08-056e4fa11826	The nomenclature, documentation and quality compliance shall be set at "Not defined". All other aspects shall be set at "Fully compliant"

²⁴ In the EF 2.0 datasets tendered by the EC, the following compliance has been used (with exactly the same meaning): PEF/OEF implementation, mandatory data 2016-2021 [source dataset UUID: 66279383-8dc3-46c1-80d1-998666cc01e6a].

ISO 14044	1adb438d-4a8b-4919-885e-0a66da3c0f2a	The nomenclature, review and quality compliance shall be set at "Not defined". All other aspects shall be set at "Fully compliant"
Environmental Footprint 2.0 Or Environmental Footprint 3.0 Or Any future reference package release	c2633e08-f120-4def-b761-a63acbd75d8c Or 3f5b0b56-60e6-4df7-869d-a811830386d9 Or	Reference package specific compliance (flow list). The nomenclature shall be set as "Fully compliant" while other aspect shall be set as "Not defined" (Note: to declare the reference package used / flow list compliance)

All these source data sets (potentially except for the one of your specific PEFCR) are available in the sources section at https://eplca.jrc.ec.europa.eu/EF-node/sourceList.xhtml?stock=EF2_0_representative_products – please make sure to include them in your ILCD/eILCD archives when providing a data set. The **compliance declarations** shall be reported under "modelling and validation" field.

5.2.16 LCIA results

The LCIA results shall be reported in the **LCIA results** section, for all 16 default EF impact categories at the end of the XML structure, in process data sets. They shall be written as scientific notation.

5.2.17 Data quality criteria and rating

Nunc The DQR of a data set shall be calculated based on the equation F.1²⁵:

$$DQR = \frac{\overline{Te_R} + \overline{Gr} + \overline{Ti_R} + \overline{P}}{4} \quad [\text{Equation F.1}]$$

Where Te_R is the Technological Representativeness, Gr is the Geographical Representativeness, Ti_R is the Time Representativeness and P is the Precision. The representativeness (technological, geographical and time-related) characterises to what degree the processes and products selected are depicting the system analysed, while the precision indicates the way the data is derived and related level of uncertainty

The DQR shall be calculated before any aggregation of sub-processes or elementary flows is performed. In particular, the procedure shall be applied before the creation of the aggregated sub-process of the level-1 disaggregated data set.

For secondary data sets (e.g., developed by database providers) the following procedure applies:

- 1) Select the most relevant sub-processes and direct (foreground) elementary flows that account for at least 80% (single score) of the total environmental impact of the secondary data set, listing them from the most contributing to the least contributing one;
- 2) Calculate the DQR criteria Te_R , Ti_R , Gr and P for each most relevant process and each most relevant direct (foreground) elementary flow. The values of each criterion shall be assigned based on

²⁵ The EF compliant data sets tendered during the pilot phase might apply a different approach, like expert judgement. The approach used is clarified in the respective data set meta data information.

Table 2. Quality rating for the data quality criteria 2.

2. A) Each most relevant foreground/direct elementary flow consists of the amount and elementary flow naming (e.g. 40 g carbon dioxide). For each most relevant foreground/direct elementary flow, evaluate the 4 DQR criteria named Te_{R-EF} , Ti_{R-EF} , Gr_{-EF} , P_{EF} . For example, evaluate the timing of the flow measured, for which technology the flow was measured and in which geographical area.
2. B) Each most relevant process is a combination of activity data and the secondary data set used. For each most relevant process, the 4 DQR criteria are calculated as follow: (i) Ti_R and P shall be evaluated at the level of the activity data (named Ti_{R-AD} , P_{AD}), while (ii) Te_R , Ti_R and Gr shall be evaluated at the level of the secondary data set used (named Te_{R-SD} , Ti_{R-AD} and Gr_{-SD}). As Ti_R is evaluated twice, the mathematical average of the activity data and secondary data set represents the Ti_R of the most relevant process.
- 3) Calculate the environmental contribution of each most-relevant process and elementary flow to the total environmental impact of all most-relevant processes and elementary flows, in % (weighted using the 16 EF impact categories). For example, the newly developed data set has only two most relevant processes, contributing in total to 80% of the total environmental impact of the data set:
- Process 1 carries 30% of the total data set environmental impact. The contribution of this process to the total of 80% is 37.5% (the latter is the weight to be used).
 - Process 2 carries 50% of the total data set environmental impact. The contribution of this process to the total of 80% is 62.5% (the latter is the weight to be used).
- 4) Calculate separately the $\overline{Te_R}$, $\overline{Gr_R}$, $\overline{Ti_R}$, \overline{P} for the secondary data set as the weighted average of each criteria of the most relevant sub-processes and most relevant direct elementary flows. The weight is the relative contribution (in %) of each most relevant process and direct elementary flow calculated in step 3.
- 5) Calculate the total DQR of the secondary data set using equation F.1, where $\overline{Te_R}$, $\overline{Gr_R}$, $\overline{Ti_R}$, \overline{P} are the weighted averages calculated as specified in point 4. In order to be EF compliant, each single criteria in cannot be higher than 3.0.

Table 2. Quality rating for the data quality criteria

Quality rating	P_{EF} and P_{AD}	Ti_{R-EF} and Ti_{R-AD}	Ti_{R-SD}	Te_{R-EF} and Te_{R-SD}	Gr_{-EF} and Gr_{-SD}
1	Measured/calculated and verified	The data (collection date) can be maximum 2 years old with respect to the "reference year" of the data set.	The "reference year" of the data set falls within the time validity of the secondary data set	Technology aspects have been modelled exactly as described in the title and metadata, without any significant need for improvement	The processes included in the data set are fully representative for the geography stated in the "location" indicated in the metadata
2	Measured/calculated/literature and plausibility checked by reviewer	The data (collection date) can be maximum 4 years old with respect to the "reference year" of the data set.	The "reference year" of the data set is maximum 2 years beyond the time validity of the secondary data set	Technology aspects are very similar to what described in the title and metadata with need for limited improvements. For example: use of generic technologies' data instead of modelling all the single plants.	The processes included in the data set are well representative for the geography stated in the "location" indicated in the metadata

Quality rating	P _{EF} and P _{AD}	Ti _{R-EF} and Ti _{R-AD}	Ti _{R-SD}	Te _{R-EF} and Te _{R-SD}	Gr _{R-EF} and Gr _{R-SD}
3	Measured/calculated/literature and plausibility not checked by reviewer OR Qualified estimate based on calculations plausibility checked by reviewer	The data (collection date) can be maximum 6 years old with respect to the "reference year" of the data set.	The "reference year" of the data set is maximum 3 years beyond the time validity of the secondary data set	Technology aspects are similar to what described in the title and metadata but merits improvements. Some of the relevant processes are not modelled with specific data but using proxies.	The processes included in the data set are sufficiently representative for the geography stated in the "location" indicated in the metadata. E.g. the represented country differs but has a very similar electricity grid mix profile,
4	Qualified estimate based on calculations, plausibility not checked by reviewer	The data (collection date) can be maximum 8 years old with respect to the "reference year" of the data set.	The "reference year" of the data set is maximum 4 years beyond the time validity of the secondary data set	Technology aspects are different from what described in the title and metadata. Requires major improvements.	The processes included in the data set are only partly representative for the geography stated in the "location" indicated in the metadata. E.g. the represented country differs and has a substantially different electricity grid mix profile
5	Rough estimate with known deficits	The data (collection date) is older than 8 years with respect to the "reference year" of the data set.	The "reference year" of the data set is more than 4 years beyond the time validity of the secondary data set	Technology aspects are completely different from what described in the title and metadata. Substantial improvement is necessary	The processes included in the data set are not representative for the geography stated in the "location" indicated in the metadata.

Ti_{R-EF}: time representativeness for the elementary flow

Ti_{R-AD}: time representativeness for the activity data

Ti_{R-SD}: time representativeness for the secondary data set

How to report the DQR for the data sets: The data set shall state as meta-data one numerical value for each DQR criteria (namely \overline{Te}_R ; \overline{Gr}_R ; \overline{Ti}_R ; \overline{P}) and the total DQR numerical value, always referred to the data set. Data quality shall be provided as text and numbers. The DQR numbers shall be presented as two digits (X.X e.g. 1.5), for the 4 individual criteria Technical Repr., Geographical Repr., Time Repr. and Precision in the field *Data quality indicators*, under *Validation* main field. Methodological appropriateness and completeness shall be set as **"Not applicable"**.

5.3 Information relevant for aggregated data sets in ILCD format

Included processes: Optionally, the sub-processes (if available as separate data sets) which are included in this data set may be referenced under *Included data sets*.

5.4 Information relevant for partly disaggregated data sets in ILCD format

Partly disaggregated data sets may contain the following types of sub-processes (see also chapter 4):

- EF compliant sub-processes (EF compliant secondary data sets from any source, in aggregated or disaggregated form)²⁶
- ILCD Entry Level compliant sub-processes (ILCD Entry level compliant secondary data sets from any source, in aggregated or disaggregated form)
- Supporting sub-processes (see chapter 5.4.2 below)
- Central data set or Reference Process

²⁶ this covers both EF secondary data sets and user-developed, other EF compliant data sets, including both unit processes and aggregated LCI results

5.4.1 Central dataset

The central data set shall carry all meta-data information of the entire model, as requested for the LCI results data sets, plus the following additional information:

Data set type: The entry shall reflect the appropriate data set type: "Partly terminated system"

Complementing processes: Within the field *Complementing processes*, all and only the central data set's sub-processes shall be referenced²⁷. The UUID and exact name of the complementing process shall be specified.

Complete flow diagram: An additional flow diagram of the model with all sub-processes and their physical relationships (what is linked to what and in which direction, as input or output), as well indicating the system boundaries for the data set shall be provided as a graphic. This graph shall be linked in addition (not replacing the activities' flow diagram) under *Flow diagram(s) or picture(s)*. The aim is to make it clear for the user which emissions and activities are included in the respective data set and which are not.

A generic template for designing in addition a systematic system boundary diagram is provided in the ILCD Handbook: Specific guide for Life Cycle Inventory (LCI) data sets, Annex E. The use of the template is recommended but not mandatory, other forms can be used as long as all included and excluded Life Cycle stages, activities, processes and flows are identified.

5.4.2 Supporting sub-processes

Supporting sub-processes are used to structure the model, like life cycle stages, transport mixers, aggregated sub-processes of several EF/ICLD compliant processes used in the central data set, or the direct emissions of the central data set.

They cannot be used stand alone, but rather they are specifically tied to and shall only be used with their corresponding central data set, as part of the disaggregated model.

They don't have to be reviewed or carry a DQR.

It is important for third parties to be able to identify these data sets, as they must not be used directly and in any other context except together with their corresponding central data set. Therefore, the following meta-data information shall be provided:

1. The following meta data fields shall be filled in with the exact information copied from the reference process (central data set; see figure 6 in chapter 3) set:
 - *Owner of data set*
 - *Commissioner of data set*
 - *License type*
 - *Access and use restrictions*
2. The *process type* shall be set as "unit process, single operation"
3. The field *Use advice for data set* shall contain the following text:

"This data set is a supporting sub-data set and must be used exclusively as sub-data set of its corresponding level-1 partly disaggregated data set (see "General comment" field for exact name and UUID)."

²⁷ This field shall not be filled in for aggregated datasets.

4. In **General comment** the following text shall be reported:

This sub-process has limited documentation only. For all detailed documentation of the full model to which this data set belongs (such as DQRs, review reports and other technical documentation), please see this process.”[fill in name of the process]” with UUID [fill in corresponding UUID of the process]

5. The following **compliance systems** (source data set) are to be linked under Compliance declarations **in the supporting sub-data set**:

Compliance declaration	Source dataset UUID	Level of compliance aspect
Environmental Footprint non-primary supporting data set (Note: to allow users to identify the sub-dataset)	2f8a3ebd-befc-4ea9-a6de-34bb6d426d2f Downloadable at: https://eplca.jrc.ec.europa.eu/EF-node/showSource.xhtml?uuid=2f8a3ebd-befc-4ea9-a6de-34bb6d426d2f	For software systems to identify the supporting sub-data set as such. <i>The quality compliance shall be set at “Not defined”. All other aspects shall be set at “Fully compliant”</i>
Environmental Footprint 2.0 Or Environmental Footprint 3.0 Or Any future reference package release	c2633e08-f120-4def-b761-a63acbd75d8c Or 3f5b0b56-60e6-4df7-869d-a811830386d9 Or	Reference package specific compliance (flow list). Shall be the same of the central dataset. The nomenclature shall be set as “Fully compliant” while other aspect shall be set as “Not defined” (Note: to declare the reference package used / flow list compliance)

6. The field **Workflow and publication status** shall be set to **Data set finalised; entirely published**.
7. As there is no “**class**” foreseen for these partial “non-processes”, where the classification is not clearly identifiable, they should all be put into “**Services**” / “**Other services**”.

6 Modelling requirements

The following methodological requirements shall be fulfilled in order to classify a data set (aggregated or disaggregated) as EF-compliant:

- **Completeness:** All 16 EF impact categories shall be covered in the data set.
- **Water use:** Water use shall be modelled at country level using separate flows for water withdrawal, water release and water evaporation at foreground and background level. For those countries not covered by the EF reference package, a flow with unspecified location shall be used. No macro- regions are available in the flow list. Therefore, for data sets covering continents as a region (e.g., for European data sets) the water flows shall be modelled as the share of the countries that are covered by the data set. For larger macro-regions, such as Rest of the World (RoW), a water flow with unspecified location may be used. Both output and input flows shall match on the level of regionalisation used, meaning that when the output is regionalised, the input shall be regionalised as well; and when the input uses a flow with unspecified location, the related output shall also use a flow with unspecified location. Water balances within a data set at country level shall be analysed by the data provider and negative balances, if any, shall be checked and explained in the meta-data information.
- **Cut-off:** Processes and elementary flows can be excluded up to 3.0%, based on material and energy flow and the level of environmental significance. The processes subject to cut-off have to be made explicit in the documentation and confirmed by the reviewer, in particular with reference to the environmental significance of the cut-off applied.
- **Emissions off-setting:** They shall not be included.
- **Capital goods (including infrastructures) and their end of life:** They shall be included unless they can be excluded based on the 3.0% cut-off rule. The eventual exclusion has to be clearly documented and checked by the reviewer.
- **System boundary:** all processes linked to the product supply chain (e.g. maintenance) shall be included in the system boundary, unless they can be excluded based on the cut-off rule.
- **Time period:** Emissions and removals shall be modelled as if released or removed at the beginning of the assessment period (no time discounting is allowed).
- **Handling multi-functional processes:** The following PEF multi- functionality decision hierarchy shall be applied for resolving all multi- functionality problems: (1) subdivision or system expansion; (2) allocation based on a relevant underlying physical relationship (substitution may apply here); (3) allocation based on some other relationship. Regarding agricultural processes, the rules provided for the "agricultural modelling" below apply.
- **Duplicated product or waste flows,** are not allowed (at input or output side)
- **Duplicated elementary flows** at input or output side are allowed.
- **The flow type 'other flows'** shall not be used in the modelling.
- **"Reference to Reference flow" field:** A single reference flow is required, which can be an input or output flow and shall be defined in the data set.
- **LCIA results:** LCIA results shall be provided in the dedicated LCIA results section of the ILCD formatted data sets, as characterised results of the 16 EF impact categories²⁸. The results shall be calculated using the latest available EF reference package and using the calculation tool Look@LCI (both available at: <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>).
- **Wastes** or other materials/activities that are part of the system boundary shall be modelled until the elementary flow level. For example, industrial process waste included in the system boundary and shall be modelled until the elementary flow level.

- **The Circular Footprint Formula (CFF)** shall be implemented at least for the products in scope of the data set. More in specific (i) to the materials that constitute the product in scope and the related waste treatments and (ii) to the packaging of the product in scope. The correct point of substitution, the formula and parameters to be used are provided in the latest PEF/OEF method, available at: <https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html>
- **Electricity modelling:** The country specific consumption mix shall be used to model processes occurring in a specific country. When a country specific mix is not available, the average EU consumption mix (EU+EFTA+UK) or region representative consumption mix shall be constructed and used. Sector specific information on the use of green electricity shall be used if available and if the set of minimum criteria²⁹ to ensure the reliability of the contractual instruments is met. The criteria met shall be described in the meta-data information and confirmed by the reviewer. This can be combined with the remaining electricity, which shall be modelled with the residual grid mix.

6.1 Which datasets to use

- Sub-processes for Energy, Transport, Packaging and End Of Life activities used to model EF compliant data sets shall be those (in aggregated form) available on the Thinkstep LCDN node "<http://lcdn.thinkstep.com/Node/>" in the proper data stock (in line with the version of the EF reference package used).
- For all other sub-processes used to model EF compliant data sets, the following hierarchy shall be applied:
 1. If there is an EF-compliant data set, this shall be used.
 2. If there is no EF-compliant data set available, an ILCD-EL compliant data set shall be used.

Commercial data sets are allowed, it is up to the data provider to decide.

6.2 Agricultural modelling

Handling multi-functional processes: The rules described in the LEAP Guideline shall be followed: 'Environmental performance of animal feeds supply chains (pages 36-43), FAO 2015, available at <https://www.fao.org/partnerships/leap/publications/en/>. In case of deviations they shall be justified, explained in the meta-data and checked by the reviewer.

Crop type specific and country-region-or-climate specific data for yield, water and land use, land use change, fertiliser (artificial and organic) amount (N, P amount) and pesticide amount (per active ingredient), per hectare per year, should be used.

Cultivation data shall be related to a period of time sufficient to provide an average assessment of the life cycle inventory associated with the inputs and outputs of cultivation that will offset fluctuations due to seasonal differences. This shall be undertaken as described in the LEAP guidelines, set out below:

²⁸ Unless decided otherwise at the kick-off meeting.

²⁹ Check the latest version of the PEF/OEF method available at <https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html>

- **For annual crops**, an assessment period of at least three years shall be used (to level out differences in crop yields related to fluctuations in growing conditions over the years such as climate, pests and diseases, et cetera). Where data covering a three-year period is not available i.e. due to starting up a new production system (e.g. new greenhouse, newly cleared land, shift to other crop), the assessment may be conducted over a shorter period, but shall be not less than 1 year. Crops/plants grown in greenhouses shall be considered as annual crops/plants, unless the cultivation cycle is significantly shorter than a year and another crop is cultivated consecutively within that year. Tomatoes, peppers and other crops which are cultivated and harvested over a longer period through the year are considered as annual crops.
- **For perennial plants** (including entire plants and edible portions of perennial plants) a steady state situation (i.e. where all development stages are proportionally represented in the studied time period) shall be assumed and a three-year period shall be used to estimate the inputs and outputs.
- Where the different stages in the cultivation cycle are known to be disproportional, a correction shall be made by adjusting the crop areas allocated to different development stages in proportion to the crop areas expected in a theoretical steady state. The application of such a correction shall be justified and reported in the meta-data information.
- **For crops that are grown and harvested in less than one year** (e.g. lettuce produced in 2 to 4 months) data shall be gathered in relation to the specific time period for production of a single crop, from at least three recent consecutive cycles. Averaging over three years can best be done by first gathering annual data and calculating the life cycle inventory per year and then determine the three years average.

Pesticide emissions shall be modelled as specific active ingredients. The pesticides applied on the field shall be modelled as 90% emitted to the agricultural soil compartment, 9% emitted to air and 1% emitted to water. More specific data might be used if available, documented in the meta-data and reviewed.

Fertiliser (and manure) emissions shall be differentiated per fertilizer type and cover as a minimum:

- NH_3 , to air (from N-fertiliser application)
- N_2O , to air (direct and indirect) (from N-fertiliser application)
- CO_2 , to air (from lime, urea and urea-compounds application)
- NO_3 , to water unspecified (leaching from N-fertiliser application)
- PO_4 , to water unspecified or freshwater (leaching and run-off of soluble phosphate from P-fertiliser application),
- P, to water unspecified or freshwater (soil particles containing phosphorous, from P-fertiliser application).
- N emissions to soil shall not be modelled. The amount of emissions ending up in the different air and water compartments per amount of fertilisers applied on the field shall be modelled within the LCI. For nitrogen based fertilisers, the Tier 1 emissions factors of IPCC 2006 (Table 2-4) should be used, as reported in the latest PEF/OEF method, available at:
<https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html>

Heavy metal emissions from field inputs shall be modelled as emission to soil and/or leaching or erosion to water. The inventory to water shall specify the oxidation state of the

metal (e.g., Cr^{+3} , Cr^{+6}). As crops assimilate part of the heavy metal emissions during their cultivation, clarification is needed on how to model crops that act as a sink. Two different modelling approaches are allowed in the PEF/OEF method, available at: <https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html> the approach chosen shall be described in the meta-data information.

Methane emissions from rice cultivation shall be included based on the calculation rules of IPCC (2006) (Volume 4, Chapter 5.5, page 44-53).

Drained peat soils shall include carbon dioxide emissions on the basis of a model that relates the drainage levels to annual carbon oxidation

The following activities shall be included in the system boundaries of agricultural modelling, if applicable and not falling within the cut-off criteria:

- Input of seed material (kg/ha),
- Input of peat to soil (kg/ha + C/N ratio),
- Input of lime (kg CaCO_3 /ha, type),
- Machine use (hours, type) (to be included if there is high level of mechanisation),
- Input N from crop residues that stay on the field or are burned (kg residue + N content/ha). Including emissions from residues burning.
- Drying and storage of products shall always be included.

Unless it is clearly documented that operations are carried out manually, field operations shall be accounted for through total fuel consumption or through inputs of specific machinery, transports to/from the field, energy for irrigation, etc.

6.3 Climate change modelling

Fossil and biogenic carbon emissions and removals: removals and emissions shall be modelled as follows:

Time period: Emissions and removals shall be calculated as if released or removed at the beginning of the assessment method (no time discount is allowed).

GHG emissions – fossil: These flows account for greenhouse gas (GHG) emissions to any media originating from the oxidation and/or reduction of fossil fuels by means of their transformation or degradation (e.g. combustion, digestion, landfilling, etc.) This impact category includes emissions from peat and calcination, and uptakes due to carbonation. Fossil CO_2 uptake and corresponding emissions (e.g. due to carbonation) shall be modelled in a simplified way when calculating the PEF profile (meaning, no emissions or uptakes shall be modelled). When the amount of fossil CO_2 uptake is required for additional environmental information, the CO_2 uptake may be modelled with the flow “ CO_2 (fossil), uptake from air”.

Modelling requirements: The flows falling under this definition shall be modelled consistently with the list of elementary flows available in the latest EF reference package. The names ending with '(fossil)' (e.g., 'carbon dioxide (fossil)' and 'methane (fossil)') shall be used if available.

Carbon emissions and uptakes – biogenic: This category covers carbon emissions to air (CO_2 , CO and CH_4) originating from the oxidation and/or reduction of aboveground biomass by means of its transformation or degradation (e.g. combustion, digestion, composting, landfilling) and CO_2 uptake from the atmosphere through photosynthesis during biomass growth – i.e. corresponding to the carbon content of products, biofuels or above ground plant residues such as litter and dead wood. Carbon exchanges from native

forests³⁰ shall be modelled under the indicator 'climate change – land use and land transformation' (including connected soil emissions, derived products or residues).

Modelling requirements: The flows falling under this definition may be included in the LCI of the data set. If the flows are modelled they shall be included by using the list of elementary flows in the latest EF reference package available, and the flow names ending with '(biogenic)'. A mass allocation shall be applied to model the biogenic carbon flows. The biogenic carbon content of the product at factory gate shall be stored in the reference flow with relevant flow property (see the chapter on element content – 5.2.9).

Carbon emissions – land use and land use change:

This category accounts for carbon uptakes and emissions (CO₂, CO and CH₄) originating from carbon stock changes caused by land use change and land use. This category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (including soil carbon emissions). For native forests, all related CO₂ emissions are included and modelled under this sub-category (including connected soil emissions, products derived from native forest³¹ and residues), while their CO₂ uptake is excluded.

Modelling requirements: The flows falling under this definition shall be modelled consistently with the list of elementary flows of the latest EF reference package available, and using the flow names ending with '(land use change)'. Biogenic carbon uptakes and emissions have to be inventoried separately for each elementary flow. For **land use change:** All carbon emissions and removals shall be modelled following the modelling guidelines of PAS 2050:2011 (BSI 2011) and the supplementary document PAS2050-1:2012 (BSI 2012) for horticultural products.

Soil carbon emissions derived from aboveground residues (except from native forest) shall be modelled under category "biogenic", such as the application of non-native forest residues or straw. Soil carbon uptake (accumulation) via improved agricultural management shall be excluded from the modelling and may be reported as meta-data

³⁰Native forests – represents native or long-term, non-degraded forests. Definition adapted from table 8 in Annex V C (2010)3751 to Directive 2009/28/EC. In principle this definition excludes short term forests, degraded forests, managed forest, and forests with short-term or long-term rotations.

³¹ Following the instantaneous oxidation approach in IPCC 2013 (Chapter 2).

7 How to structure and document nodes and data stocks

Each EF compliant data set shall be published on a node free of choice by the data developer. A node shall carry different data stocks. Each data stock shall be named starting with the version number of the EF reference package it is compliant with (e.g., EF2_0_representative_products).

Single EF compliant data sets provided by industries can be published upon request by the JRC on a node managed by the European Commission. The data provider stays responsible for the quality, compliance and review declarations of the data sets.

A data stock may contain both ILCD- and EF-compliant data sets. Any data set contained in the same data stock SHALL be compliant with the reference flow list of the same EF reference package. On the landing page of the node the data stock structure shall be explained and the following text may be used:

Within this node, each data stock may contain both EF compliant data sets and/or ILCD-compliant data sets. The nomenclature of all data sets contained within one data stock is compliant with the same EF reference package mentioned in the data stock name. Please carefully check the compliance level of the data sets.

The End User License Agreement shall be linked from the landing page of the node, where a contact email address shall be provided as well. The developer of the data shall ensure that the new data set is made available on a node that provides these user rights, and requests the user of the data sets to agree on the conditions of the EULA³².

For each new node and also for each data stock, a corresponding source data set shall be generated by the developer of the node. Such a source data set shall carry a description and a hyperlink to the node or data stock, respectively. Examples for both are given below.

Data set information	
Short name	Data on organic vegetables
Classification	Class name : Hierarchy level ILCD: Databases
Source citation	Node of ACME
Publication type	Software or database
Source description or comment	created by ACME, Inc. for the EU Product Environmental (PEF) pilot phase implementation
Link to digital file	https://data.acme.com/
Belongs to	ACME

Figure 9. Example source data set pointing to a node

Data set information	
Short name	Data for EF provided by ACME, EF 2.0 compliant (data stock)
Classification	Class name : Hierarchy level ILCD: Databases
Publication type	Software or database
Source description or comment	Data stock with EF 2.0 compliant datasets created for the EC Product Environmental (PEF) pilot phase implementation
Link to digital file	https://data.acme.com/?stockId=d7fd8b37-3df1-46b9-b114-069870984e46&stock=EF2_0_ACME
Belongs to	ACME

³² End User's License Agreement – ask data providers for that, or find it on the providers' nodes.

Figure 10. Example source data set pointing to a specific data stock

8 Reviewer requirements for Environmental Footprint process data sets and review report template

8.1 Eligibility

Reviewer's requirements are used to assess the eligibility of reviewers and are automatically applied in the Reviewer Registry (<https://eplca.jrc.ec.europa.eu/ResourceDirectory/>), accessible through the European Platform on Life Cycle Assessment (<https://eplca.jrc.ec.europa.eu/>). The registry allows the selection of specific requirements, including the Environmental Footprint (for critical review) and ILCD Entry Level (EL) requirements (JRC-2016)³³. The Reviewer's Registry can be used for the selection and the eligibility assessment of the reviewers.

The minimum requirements for reviewer's eligibility adopted for the ILCD-EL requirements, are to be applied for the review of EF compliant data sets (see table 3). A set of minimum requirements for reviewers under the EF scheme (both as single reviewers or reviewers' teams) are also described in the Recommendation 2013/179/EU, however this defines the scoring system for CRITICAL review (chapter 9), thus the EF eligibility in the Reviewer Registry refers to that scheme, not to the one requested for normal data review.

Table 3. Minimum requirements for reviewer's eligibility in the EF and ILCD-EL compliance. The reviewer skills can also be fulfilled by a team (e.g. one of the reviewer fulfils the minimum requirements for LCA experience and another one the sector-specific minimum requirement).

ILCD EL and EF		
Verification and audit practice	Years of experience ¹	> 2
	Number of reviews ²	> 2
LCA methodology and practice	Years of experience ³	> 2
	Participation in LCI work ⁴	> 4
Knowledge of technologies or other activities, per sector covered ⁵		
NACE main sector	Years of experience in public and/or private organisations	> 2

¹ Experience in auditing and review in the environmental field not only LC-based; ² As reviewer, LCA (ISO, ILCD or EF compliant) or EPDs or LCI data sets, other LC-based requirements; ³ Starting from Master's degree if mainly focused on LCA; ⁴ Development/modelling of LCI data sets (documented); ⁵ Experience by specific macro sector (NACE), at any level (work, monitoring, management, R & D, etc.)

8.2 Reviewer types

Nunc As regards the relationship of the reviewer/team with the data developer or provider, the following cases can be identified:

³³ Review schemes and reviewers' selection criteria in the Life Cycle Data Network framework, and at global level <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC104639/lbna28277enn.pdf>

- **Independent external reviewer/team:** the reviewer shall not be involved in the definition or development of the reviewed case. This includes both the reviewer as a person and the employer (if any) as an organisation. The person or team has to be external, and without relevant relations for at least 1 year to any organisation that performed, commissioned, financed or otherwise had relevant influence on the study to be reviewed. The phrase 'relevant relations' includes financial (beyond the agreement for the review itself and other reviews in the same framework, which are of course allowed), legal or similar ties that would result in a conflict of interest such as subsidies, joint-venture partners, development partners, sales partners, or any other strategic cooperation partners.
- **Independent internal reviewer/team:** the reviewer shall not be involved in the study to be reviewed, or quantitatively relevant parts (e.g. background data) but can be part of the organisation that performed or commissioned the LCA work (or related third party organisations).
- **Dependent internal reviewer/team:** the reviewer can be involved in the study to be reviewed, or quantitatively relevant parts (e.g. background data) and part of the organisation that performed or commissioned the LCA work. This type of reviewer is defined by ISO standard, but is not eligible in the schemes considered in this report.

Five different review types are identified according to the type of reviewer and composition of the review team (see table 4)³⁴. **In the EF requirements only the first two cases are allowed**

Table 4. Type of review identified in the EF scheme (the term "reviewer" refers to a single reviewer or a team fulfilling the minimum requirements mentioned above). Only types 1 and 2 are allowed in the EF compliant data review.

Typology and number of reviewers	Type 1	at least 3 independent reviewers, with at least 1 external
	Type 2	Two independent reviewers, with at least 1 external
	Type 3	Two independent internal reviewers
	Type 4	One independent external reviewer
	Type 5	One independent internal reviewer

8.3 Requirements for the review report

Under the EF requirements a review report is mandatory. The detailed review report template presented in Table 5 shall be filled in by the team. Only one review report per data set is allowed, together with its single DQR, agreed upon and signed off by the reviewer team. The report shall be attached to the data set on the node under the field "complete review report" (within the validation table) and made visible in the EF registry of the Life Cycle Data Network.

In Table 5, all review compliancy aspects shall be answered with "Yes" or have to be fulfilled to claim EF compliancy. In case these items are answered with "no", the data set shall be improved to remove the non-compliances.

³⁴ <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC104639/lbna28277enn.pdf>

If a data set is updated in core content (i.e. LCI, DQRs, LCIA results etc.) a partial review on the new content of the data set is required to be compliant.

A review report template is available in the EF developer's page at: <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>.

Table 5. EF review report template, with comments. Comments and suggestion on how to fill in the different fields are reported in italic.

REVIEW REPORTING			
General information			
Data set name	<i>Name of the data set, e.g. Electricity grid mix 1 kV-60 kV; AC; consumption mix, at consumer; 1 kV-60 kV</i>		
Data set UUID and version number	<i>Unique Identifier (UUID) of the data set (the filename is a 36 digits alphanumeric code with the following structure xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxxxx</i>		
Data set locator (e.g. Permanent URI, URL, contact point, or database name and version, etc.)	<i>Permanent URI, URL, contact point, or database name and version, etc.</i>		
Review commissioner(s)	<i>Owner of the data set or data set/ database developer or supplier</i>		
Reviewer name(s) and affiliation(s), contact			
Review type applied, and compliance with EF requirements for review	<i>Reviewer type 1 or 2 (see table 3)</i>		
Method used for review , and review scope	<i>Description of the method adopted to perform the review: e.g. for review of a large number of data sets, specify if each data set has been reviewed by checking each single data point, or if the underlying general model was reviewed + spot check of some parameters in all data sets, or + spot check of all parameters in x% of data sets, etc.</i>		
Date of review completion	<i>(DD/MM/YYYY)</i>		
Reviewed against/Compliance system name	PEF/OEF		
Compatibility with EF reference package (Version)	Declare the version of EF reference package used		
OVERALL COMPLIANCE ASSESSMENT			
aspect	yes	no	comments
Compliance with specific EF requirements			<i>The data set is compliant with all requirements of the reference documents (e.g. reference PEFCR, PEF Guide, PEFCR Guidance). The documentation is complete and clearly describes how the requirements have been applied in the data set (e.g. agricultural modelling, transport, electricity, etc. see Chapter 7 of the PEFCR Guidance)</i>
Allocation rules clearly explained and consistent			<i>Allocation applied in the foreground system is clearly explained and documented (type of allocation (mass, economic...); allocation factors...)</i>

Circular Footprint Formula (correct implementation)			Check the use of appropriate parameters values. Check point of substitution. Check assumptions for E*v. UUID of data sets used to model the emission profiles of the different parameters are reported. Documentation describing the implementation of the CFF and parameters used is clear with respect to the above checks.
LCIA results consistency			Compare the LCIA results inside the data set(s) with the results calculated with Look@LCI ³⁵ . Discrepancies >1% are not EF Compliant.
Nomenclature			
Correctness and consistency of applied nomenclature (use of Specific EF reference package; Correct nomenclature of other flows, processes etc.)			
Documentation			
Appropriateness of documentation. See Document 'Documentation of LCA data sets ³⁶ ' and additional EF compliant data guide above.	Documentation is or is not EF compliant (content-wise)? It enables a fair appraisal of the data set or not? Which information are detailed? Which are lacking (if any)? Metadata are detailed enough and respecting ILCD entry-level and additional EF requirements?		
Appropriateness / correctness of documentation format (ILCD Format)	The ILCD format is respected? The document has been validated with the ILCD validation tool? The non-compliant aspects (if any) have been solved? (In order to share data through the LCDN the data package has to be submitted in correct ILCD format.)		
Validation with ILCD Validation tool			If "no", indicate which aspects are not compliant
DQRs			The reviewer takes the responsibility of the DQR declaration. Only one DQR per data set and expressed with two digits (X.X) ³⁷ . It can be either calculated by the reviewer or the data set developer. The reviewer shall certify the correctness of the values.
Cut-off	Verify the compliance with PEFCR guidance on the cut-off rules applied in the model		

Additional Information can be added if needed.

³⁵ Calculation tool developed by JRC and available with user instructions at <https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>

³⁶ JRC 2011 [https://eplca.jrc.ec.europa.eu/uploads/ILCD-GuidanceDocumentationLCADData sets-Version1-1Beta-2011-ISBN-clean.pdf](https://eplca.jrc.ec.europa.eu/uploads/ILCD-GuidanceDocumentationLCADData%20sets-Version1-1Beta-2011-ISBN-clean.pdf)

³⁷ To be calculated with 4 criteria (Technical Repr., Geographical Repr., Time Repr. and Precision). The methodological appropriateness and completeness shall be set to 'Not applicable'.

Documents referred or accessed by the reviewer (either public or confidential) shall be added as references.

The reviewer shall close and sign the review report with an EF compliancy declaration: "The reviewers declare on their responsibility that the reviewed data set is compliant with the Environmental Footprint general and specific compliancy rules."

9 References

2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations.

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JRC 2016 - European Commission - Joint Research Centre – Directorate D - Fazio S. Review schemes and reviewers' selection criteria in the Life Cycle Data Network framework, and at global level; EUR 28277 EN doi:10.2788/573305 Luxembourg: Publications Office of the European Union, 2016

JRC 2019 - European Commission - Joint Research Centre – Directorate D – Zampori L., Pant R. "Suggestions for updating the Product Environmental Footprint (PEF) method"; EUR 29682 EN doi:10.2760/265244 Luxembourg: Publications Office of the European Union, 2019.

List of abbreviations and definitions

CFF - Circular Footprint Formula
DQR - Data Quality Rating
EF - Environmental Footprint
eILCD - extended ILCD format
ILCD - International Life Cycle Data system
ILCD-EL - International Life Cycle Data system - Entry Level Requirements
JRC - Joint Research Centre
LCI - Life Cycle Inventory
LCIA - Life Cycle Impact Assessment
OEF - Organisation Environmental Footprint
PEF - Product Environmental Footprint
PEFCR - Product Environmental Footprint Category Rules
UUID - Universally unique identifier

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Annexes

Annex 1. allowed regionalized elementary flows

Beyond the flows related to Land Use and Water Use, for which all the global location (country) codes are allowed, the regionalization is also possible for the following substances and UUIDs, and only for the specified location codes

Table 6. Flows, beyond water use and land use where the regionalization is allowed

08a91e70-3ddc-11dd-96ae-0050c2490048	ammonia	Emissions to urban air close to ground
2905c64e-6556-11dd-ad8b-0800200c9a66	ammonia	Emissions to lower stratosphere and upper troposphere
08a91e70-3ddc-11dd-a2aa-0050c2490048	ammonia	Emissions to air, unspecified (long-term)
08a91e70-3ddc-11dd-a2a9-0050c2490048	ammonia	Emissions to air, unspecified
08a91e70-3ddc-11dd-96af-0050c2490048	ammonia	Emissions to non-urban air or from high stacks
08a91e70-3ddc-11dd-96e5-0050c2490048	nitrogen dioxide	Emissions to air, unspecified
08a91e70-3ddc-11dd-96e6-0050c2490048	nitrogen dioxide	Emissions to air, unspecified (long-term)
08a91e70-3ddc-11dd-96e7-0050c2490048	nitrogen dioxide	Emissions to urban air close to ground
08a91e70-3ddc-11dd-96e8-0050c2490048	nitrogen dioxide	Emissions to non-urban air or from high stacks
08a91e70-3ddc-11dd-96e9-0050c2490048	nitrogen dioxide	Emissions to lower stratosphere and upper troposphere
191b44d4-90c9-465a-8802-93a651b4fd52	Nitrogen oxides	Emissions to non-urban air or from high stacks
1c952836-ea05-43db-9063-0c5e1ee65fa8	Nitrogen oxides	Emissions to lower stratosphere and upper troposphere
2f89fbdb-e428-4de1-8c33-9dd66e53310c	Nitrogen oxides	Emissions to air, unspecified (long-term)
e575ebc3-0a3b-4c38-9a2a-13e42c72553b	Nitrogen oxides	Emissions to urban air close to ground
f79d0f8f-2b0e-49cb-bed0-b1ea0fbd8625	Nitrogen oxides	Emissions to air, unspecified
fe0acd60-3ddc-11dd-ac49-0050c2490048	sulfur dioxide	Emissions to air, unspecified (long-term)
fe0acd60-3ddc-11dd-ac48-0050c2490048	sulfur dioxide	Emissions to air, unspecified
fe0acd60-3ddc-11dd-ac4c-0050c2490048	sulfur dioxide	Emissions to lower stratosphere and upper troposphere
fe0acd60-3ddc-11dd-ac4b-0050c2490048	sulfur dioxide	Emissions to non-urban air or from high stacks
fe0acd60-3ddc-11dd-ac4a-0050c2490048	sulfur dioxide	Emissions to urban air close to ground
2905c636-6556-11dd-ad8b-0800200c9a66	sulfur oxides	Emissions to lower stratosphere and upper troposphere
fe0acd60-3ddc-11dd-a208-0050c2490048	sulfur oxides	Emissions to air, unspecified (long-term)
fe0acd60-3ddc-11dd-a207-0050c2490048	sulfur oxides	Emissions to air, unspecified
fe0acd60-3ddc-11dd-a20a-0050c2490048	sulfur oxides	Emissions to urban air close to ground
fe0acd60-3ddc-11dd-a209-0050c2490048	sulfur oxides	Emissions to non-urban air or from high stacks

Table 7. Location codes and related countries allowed for the above mentioned flows

AL	Albania	DE	Germany	HU	Hungary	NO	Norway
AT	Austria	DK	Denmark	IE	Ireland	PL	Poland
BA	Bosnia and Herzegovina	EE	Estonia	IT	Italy	PT	Portugal
BE	Belgium	ES	Spain	LT	Lithuania	RO	Romania
BG	Bulgaria	FI	Finland	LU	Luxemburg	RU	Russian Federation
BY	Belarus	FR	France	LV	Latvia	SE	Sweden
CH	Switzerland	GB	United Kingdom	MD	Moldova	SI	Slovenia
CS	Serbia And Montenegro*	GR	Greece	MK	Macedonia	SK	Slovakia
CZ	Czech Republic	HR	Croatia	NL	Netherlands	UA	Ukraine

* Still allowed but to be changed in RS for Serbia, and ME for Montenegro

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